TOSHIBA 04838660

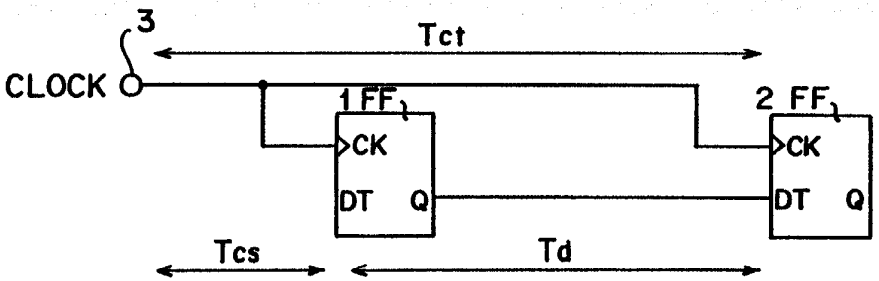
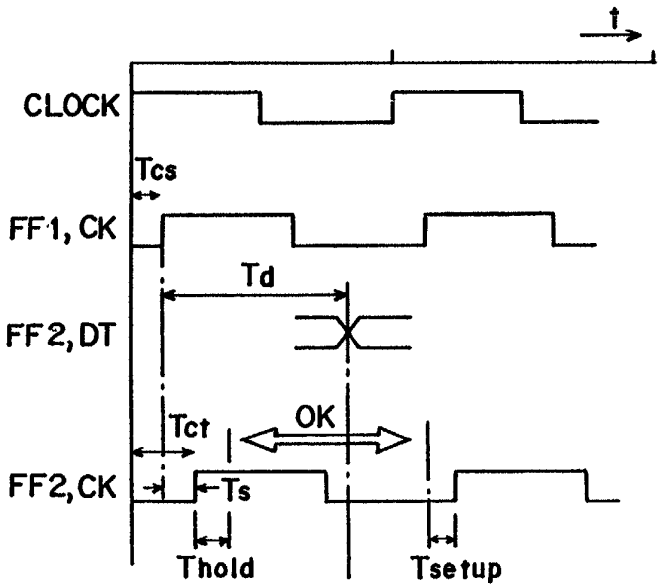


FIG. 1A PRIOR ART



- OVERDELAY CHECK
  (SETUP TIME CHECK)
  $Tcs + Td - Tct + Tsetup \leqq \tau$
- RACING CHECK
  (HOLD TIME CHECK)
  $Tcs + Td - Tct - Thold \geqq 0$

FIG. 1B PRIOR ART

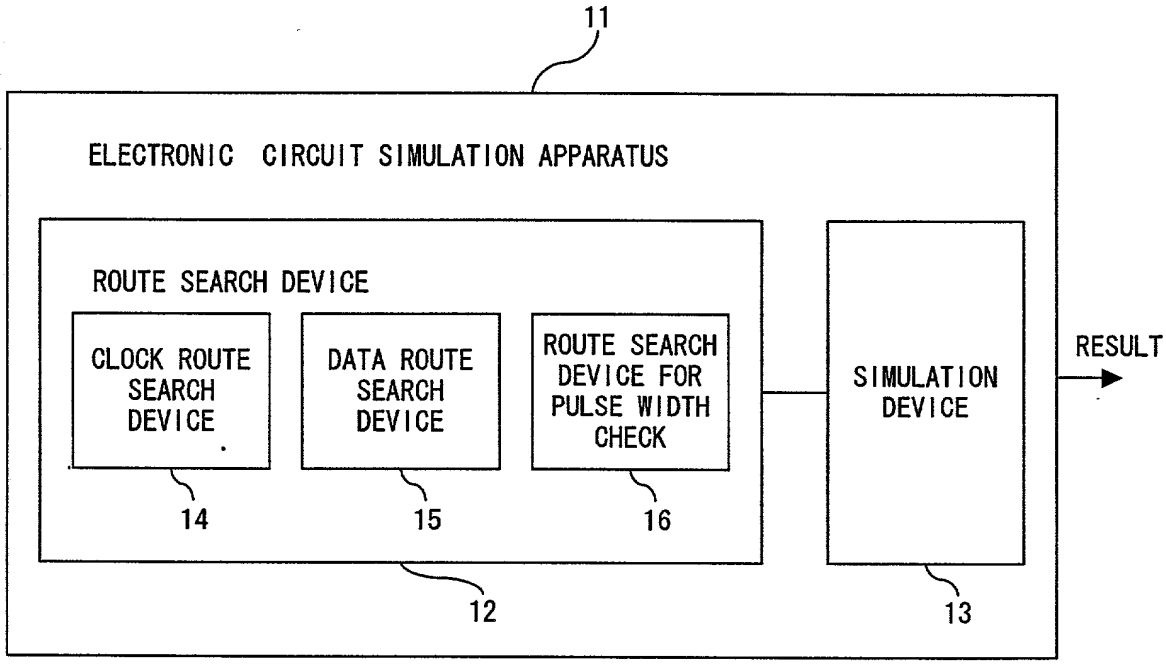

11
ELECTRONIC CIRCUIT SIMULATION APPARATUS
ROUTE SEARCH DEVICE
CLOCK ROUTE SEARCH DEVICE
DATA ROUTE SEARCH DEVICE
ROUTE SEARCH DEVICE FOR PULSE WIDTH CHECK
SIMULATION DEVICE
RESULT
14
15
16
12
13

FIG. 2

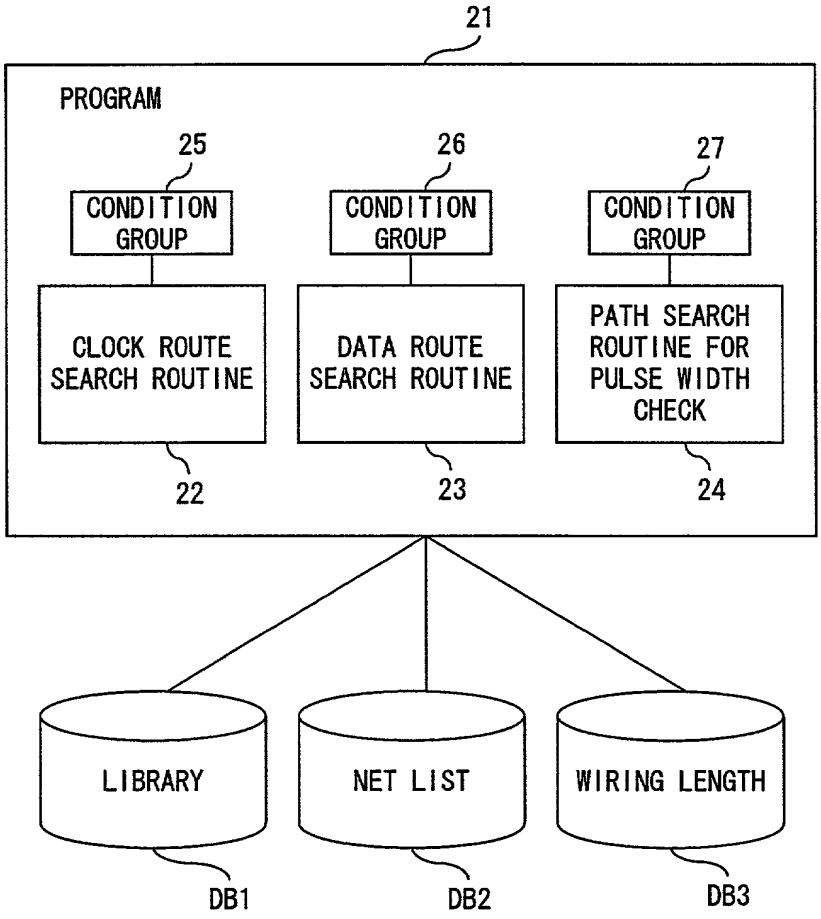

21
PROGRAM
25
26
27
CONDITION GROUP
CONDITION GROUP
CONDITION GROUP
CLOCK ROUTE SEARCH ROUTINE
DATA ROUTE SEARCH ROUTINE
PATH SEARCH ROUTINE FOR PULSE WIDTH CHECK
22
23
24
LIBRARY
NET LIST
WIRING LENGTH
DB1
DB2
DB3

FIG. 3

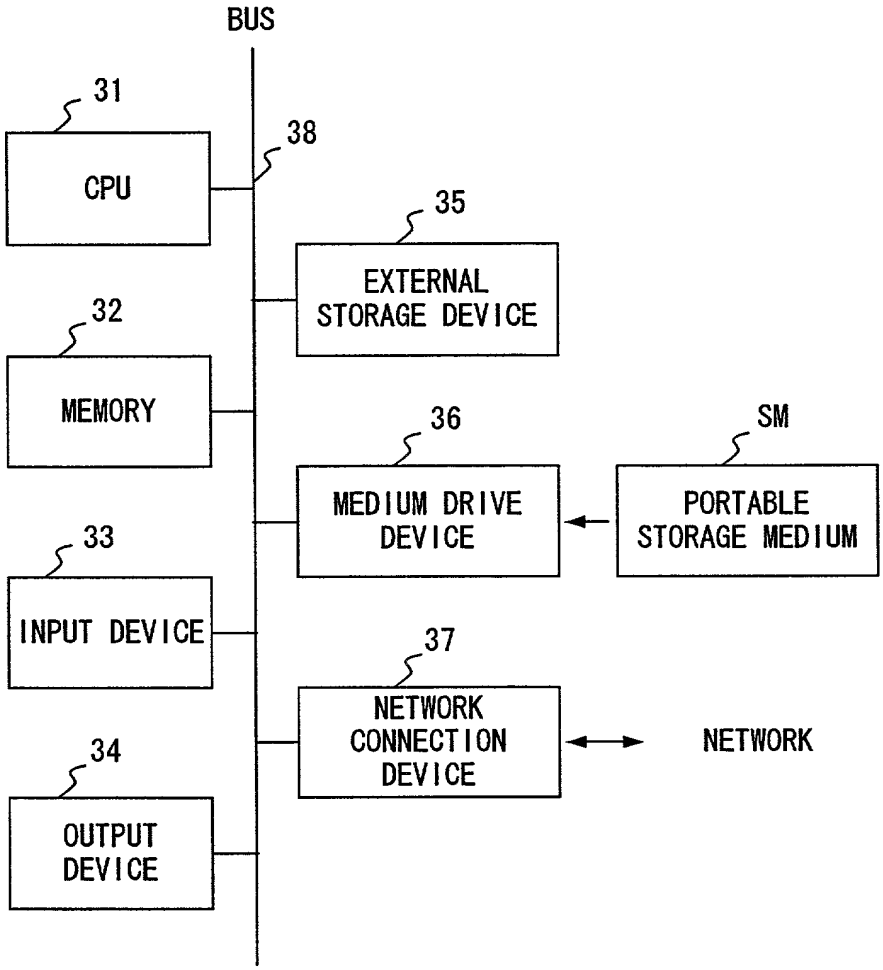

BUS
31
CPU
38
35
EXTERNAL STORAGE DEVICE
32
MEMORY
36
SM
MEDIUM DRIVE DEVICE
PORTABLE STORAGE MEDIUM
33
INPUT DEVICE
37
NETWORK CONNECTION DEVICE
NETWORK
34
OUTPUT DEVICE

FIG. 4

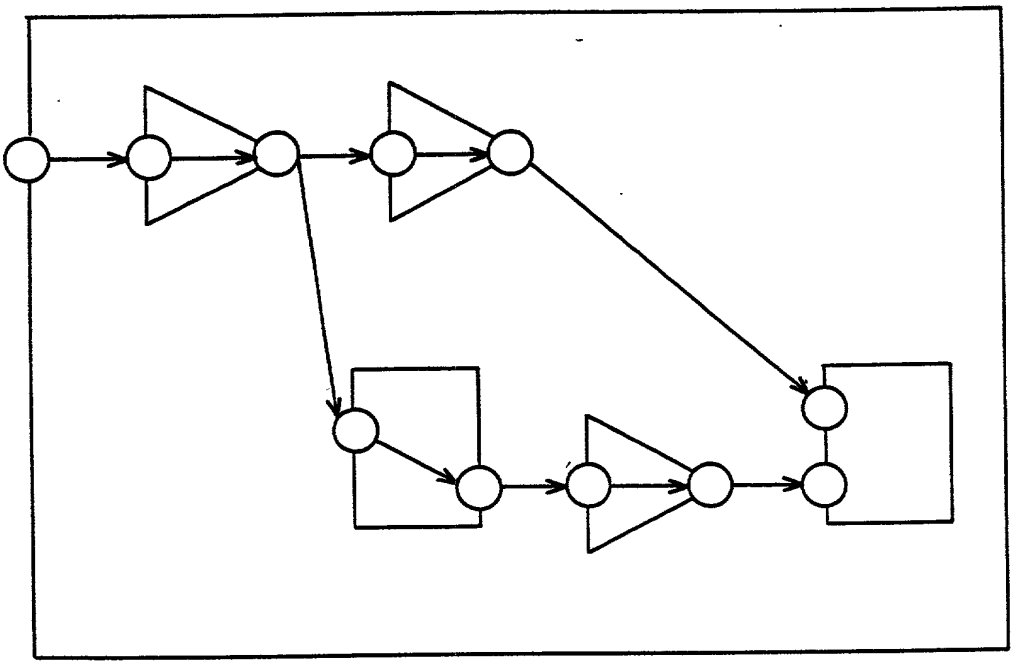


FIG. 5

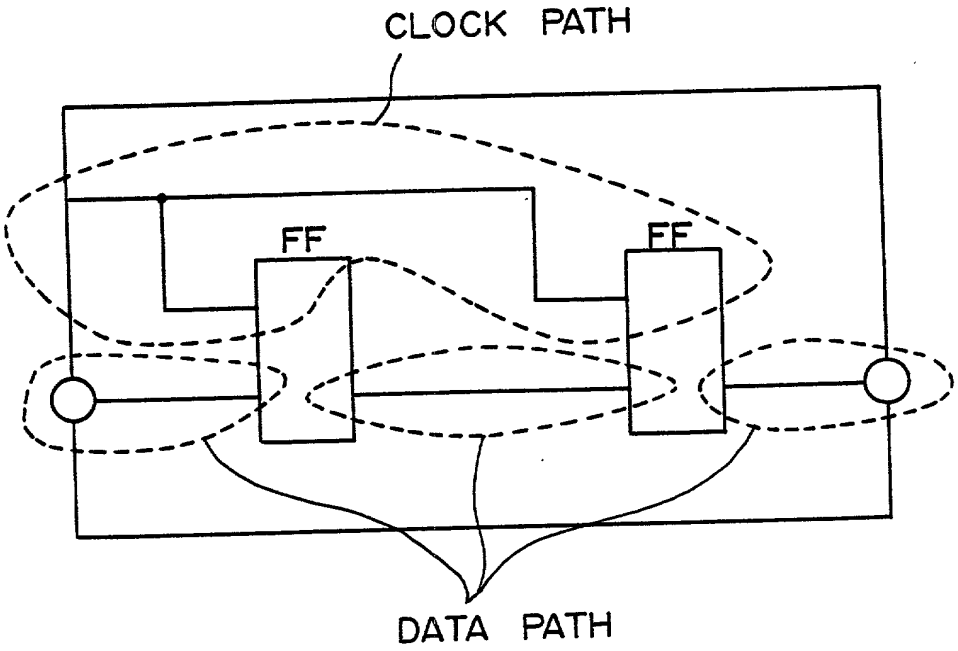


FIG. 6

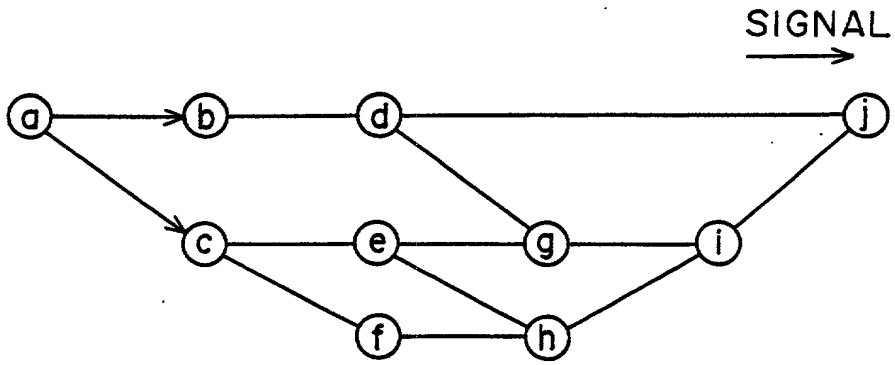


FIG. 7

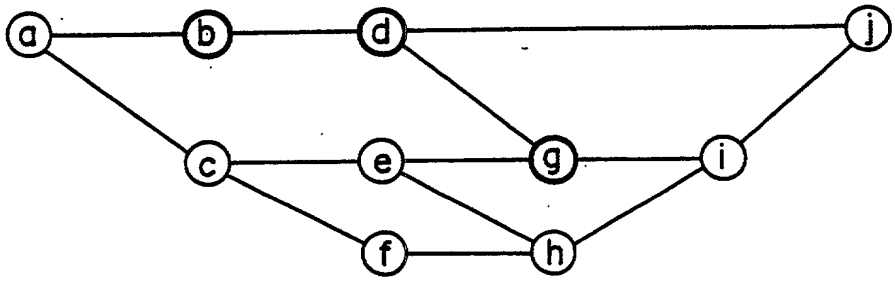


FIG. 8

Patent Application Publication

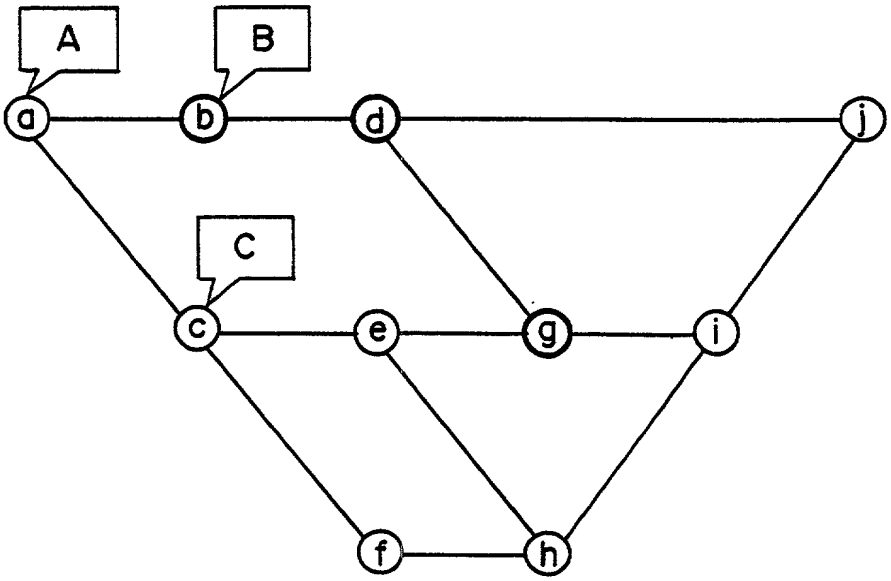


FIG. 9A

EVENT	EVENT AT PREVIOUS STAGE	ROUTE IDENTIFICATION CODE
A		0
B	A	0
C	A	0

FIG. 9B

Patent Application

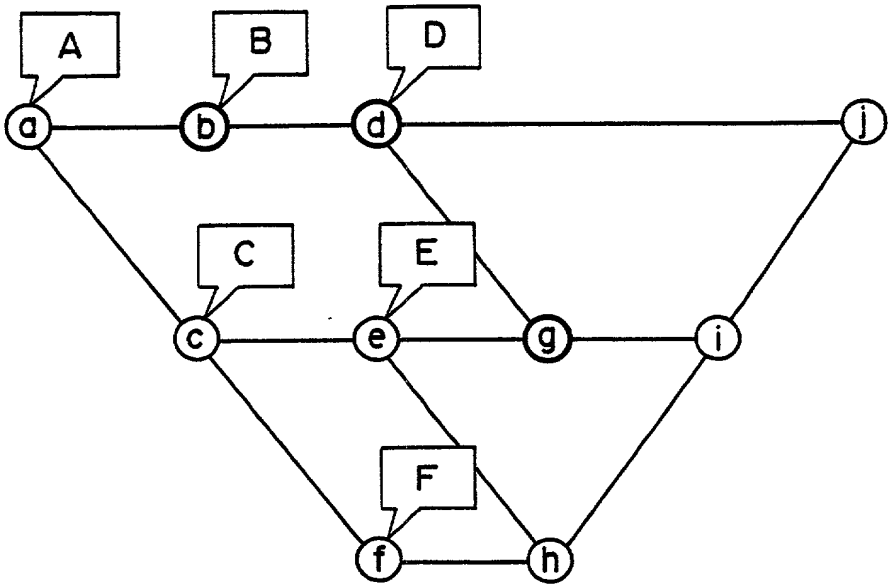


FIG. 10A

EVENT	EVENT AT PREVIOUS STAGE	ROUTE IDENTIFICATION CODE
A	NONE	0
B	A	0
C	A	0
D	B	1
E	C	0
F	C	0

FIG. 10B

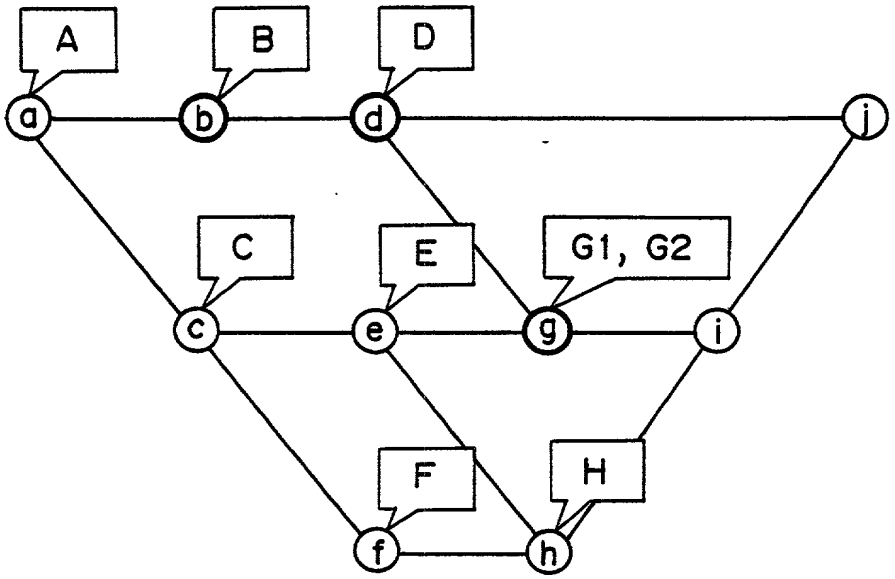


FIG. 11A

EVENT	PREVIOUS STAGE	ROUTE IDENTIFICATION CODE
A	NONE	0
B	A	0
C	A	0
D	B	1
E	C	0
F	C	0
G1	D	2
G2	E	0
H	F	0

FIG. 11B

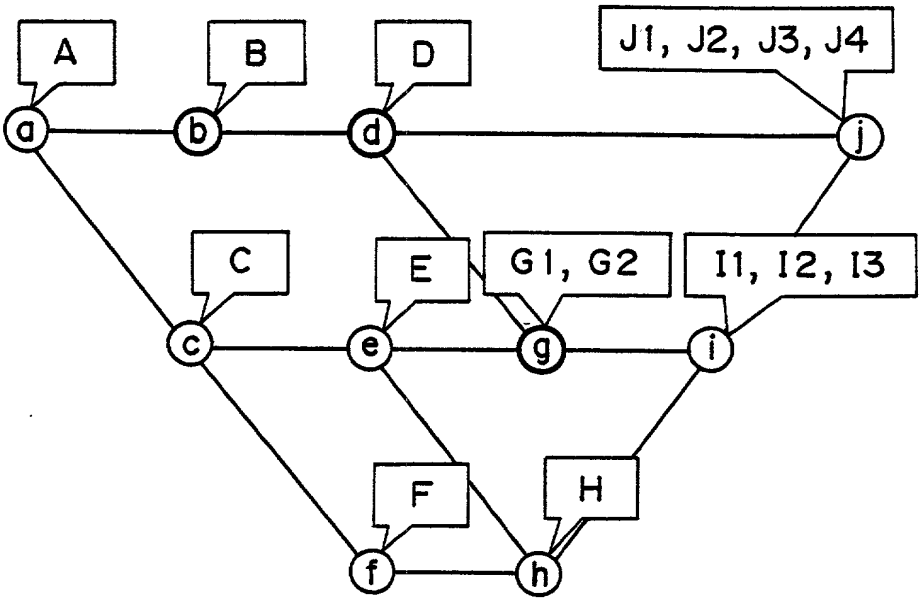


FIG. 12A

EVENT	PREVIOUS STAGE	ROUTE IDENTIFICATION CODE
A	NONE	0
B	A	0
C	A	0
D	B	1
E	C	0
F	C	0
G1	D	2
G2	E	0
H	F	0
I1	G1	3
I2	G2	4
I3	H	0
J1	D	5
J2	I1	3
J3	I2	4
J4	I3	0

FIG. 12B

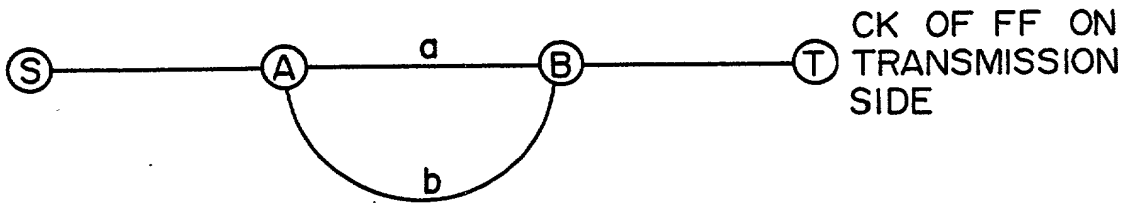


FIG. 13

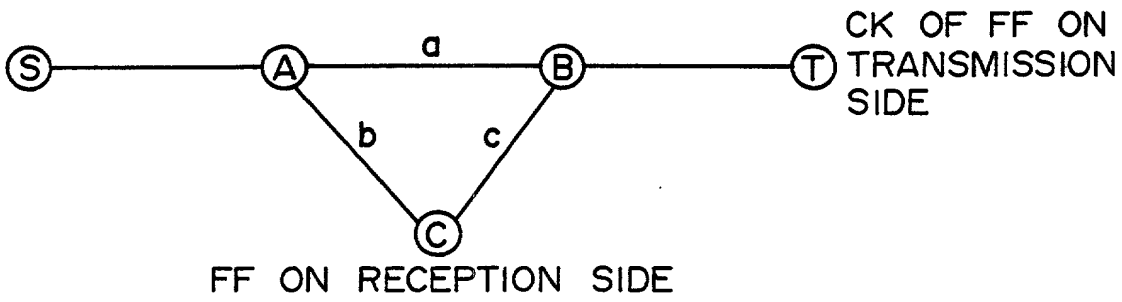


FIG. 14

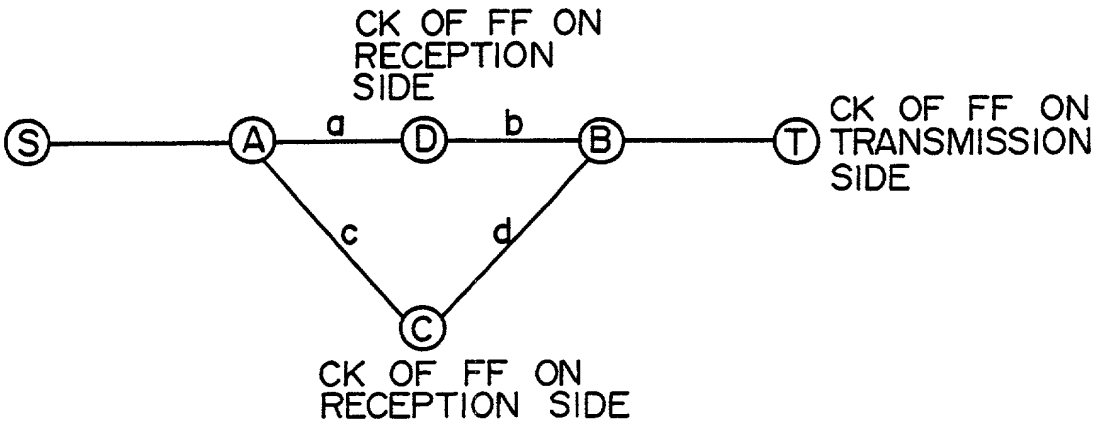

CK OF FF ON
RECEPTION
SIDE
S
A
a
D
b
B
T
CK OF FF ON
TRANSMISSION
SIDE
c
d
C
CK OF FF ON
RECEPTION SIDE

FIG. 15

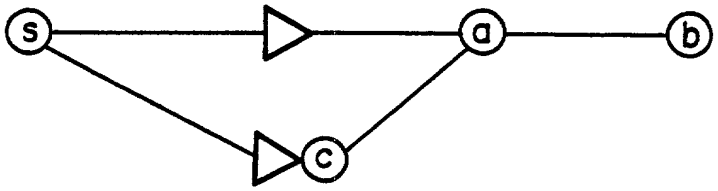


FIG. 16

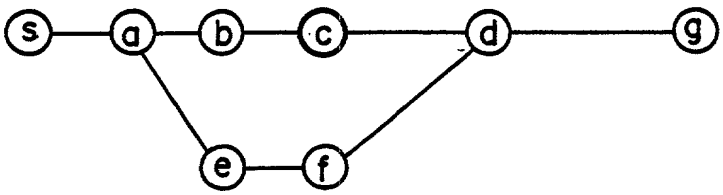


FIG. 17

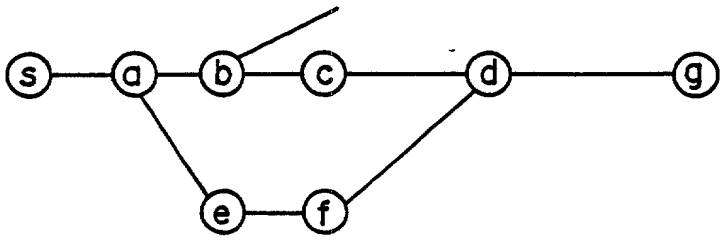


FIG. 18

Document ID: US 6,256,774 B1

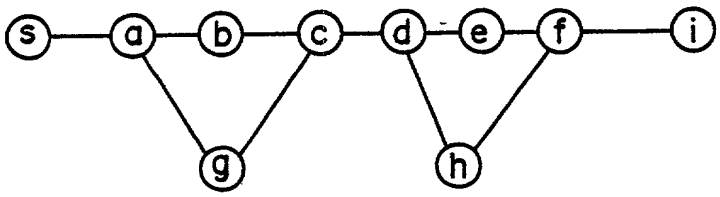


FIG. 19

Patented Aug. 26, 1975

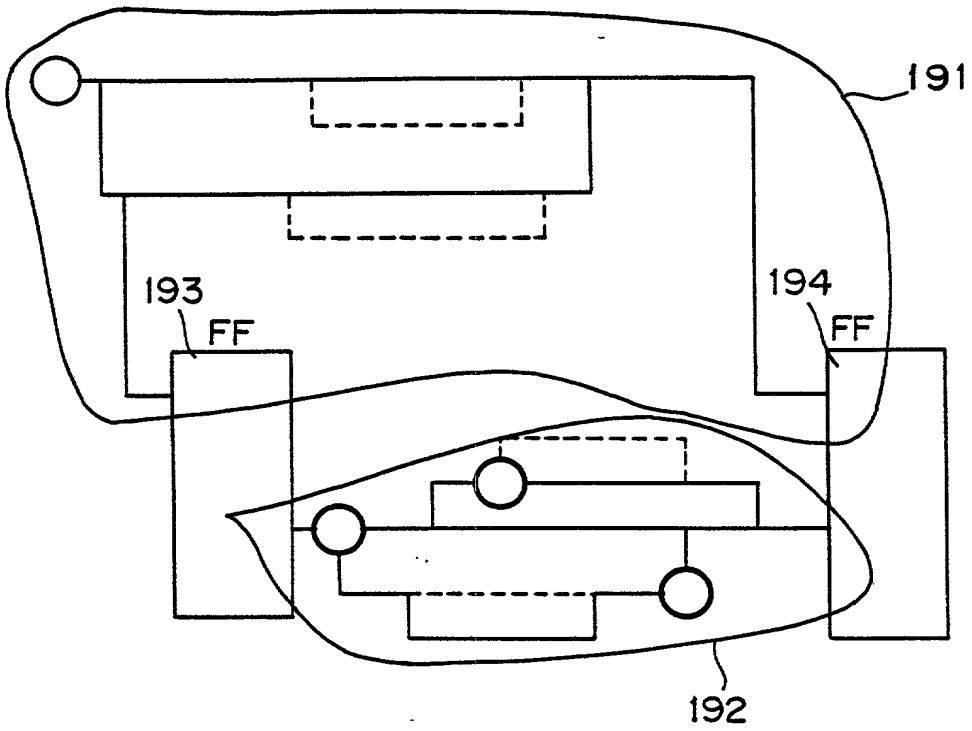


FIG. 20

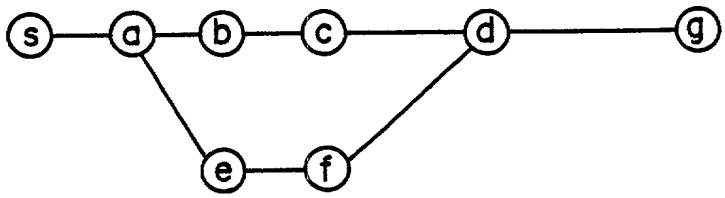


FIG. 21

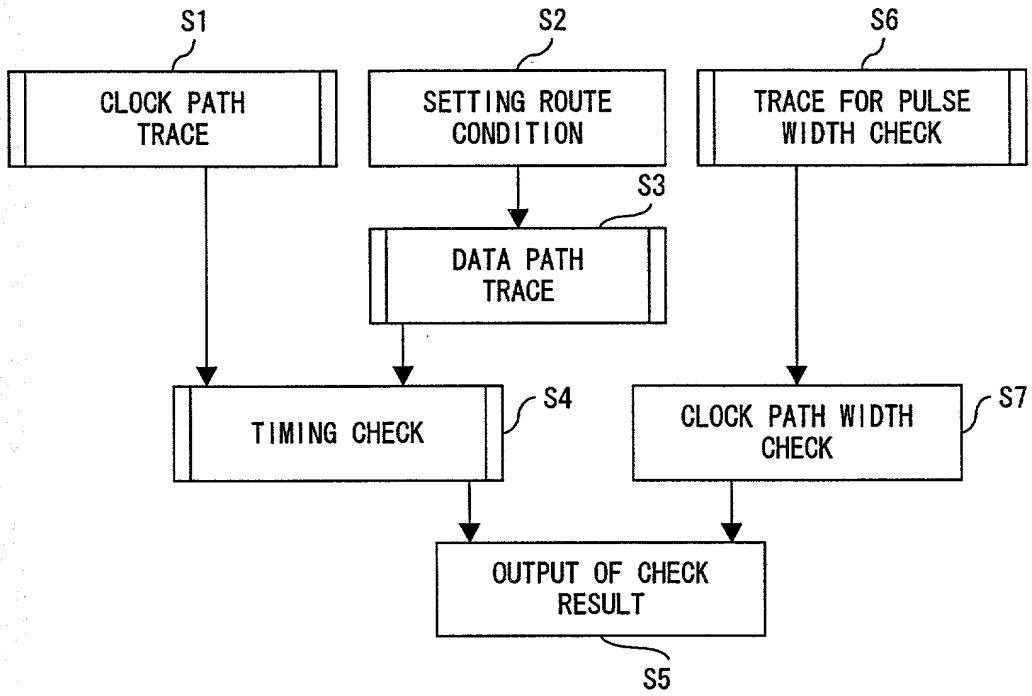

S1
CLOCK PATH TRACE
S2
SETTING ROUTE CONDITION
S6
TRACE FOR PULSE WIDTH CHECK
S3
DATA PATH TRACE
S4
TIMING CHECK
S7
CLOCK PATH WIDTH CHECK
OUTPUT OF CHECK RESULT
S5

FIG. 22

Patent Application Publication

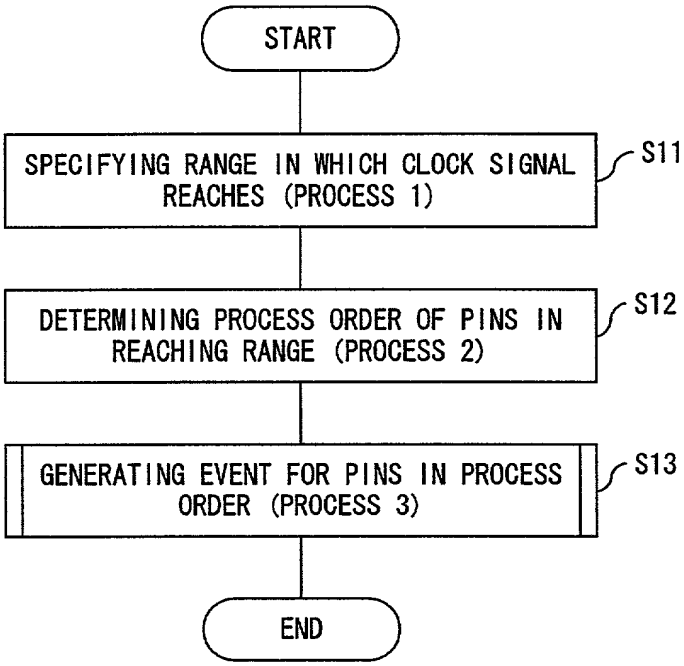


FIG. 23

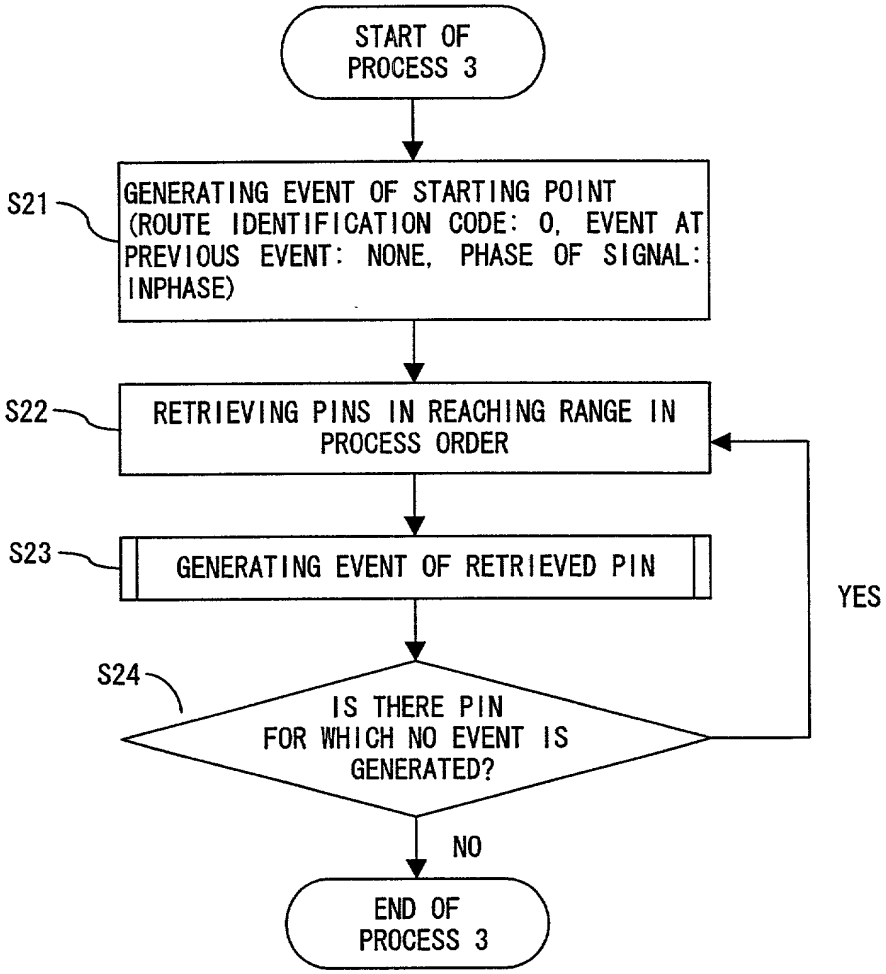

START OF PROCESS 3
S21
GENERATING EVENT OF STARTING POINT (ROUTE IDENTIFICATION CODE: 0, EVENT AT PREVIOUS EVENT: NONE, PHASE OF SIGNAL: INPHASE)
S22
RETRIEVING PINS IN REACHING RANGE IN PROCESS ORDER
S23
GENERATING EVENT OF RETRIEVED PIN
S24
IS THERE PIN FOR WHICH NO EVENT IS GENERATED?
YES
NO
END OF PROCESS 3

FIG. 24

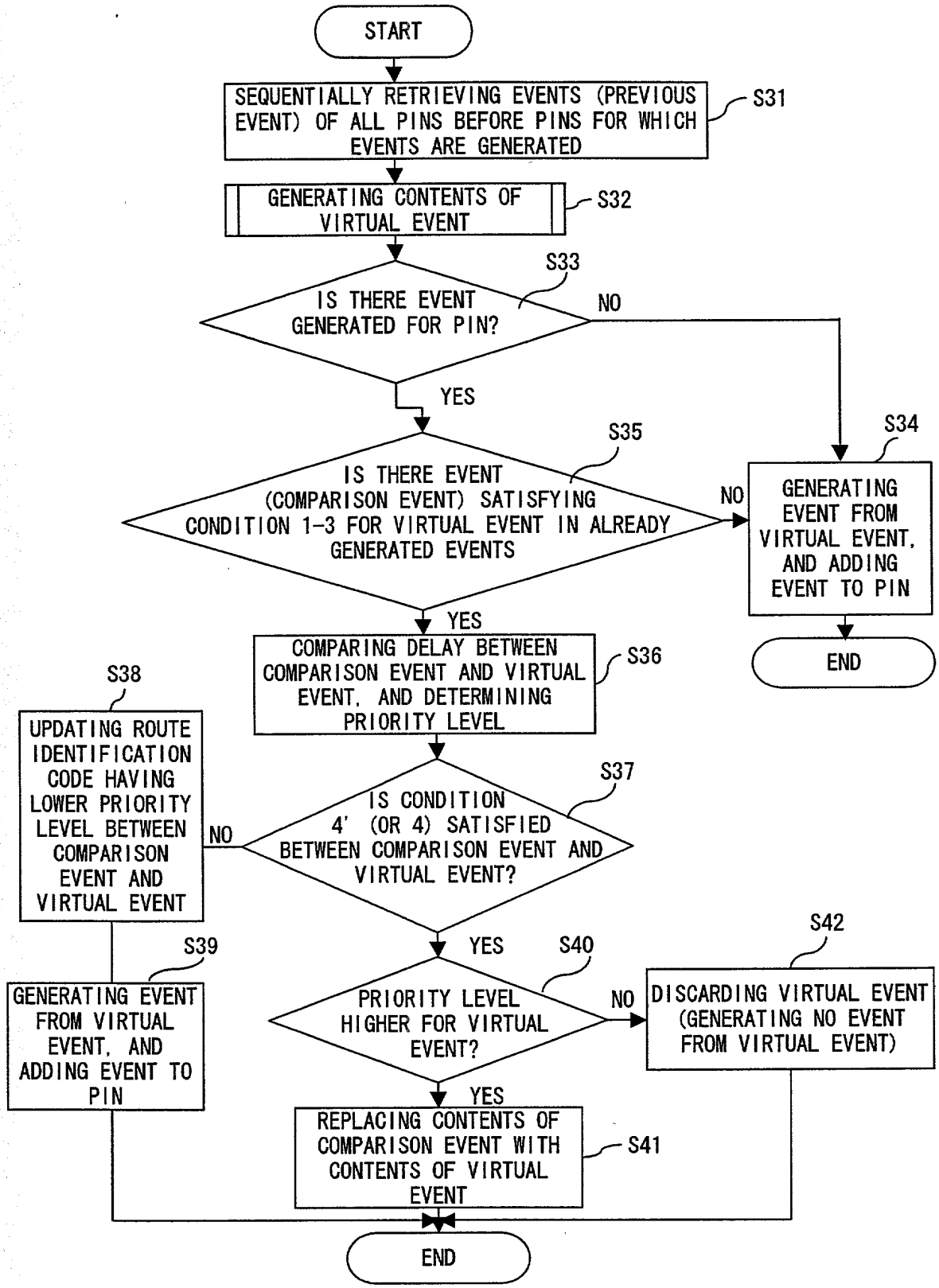

START
SEQUENTIALLY RETRIEVING EVENTS (PREVIOUS EVENT) OF ALL PINS BEFORE PINS FOR WHICH EVENTS ARE GENERATED
S31
GENERATING CONTENTS OF VIRTUAL EVENT
S32
S33
IS THERE EVENT GENERATED FOR PIN?
NO
YES
S34
S35
IS THERE EVENT (COMPARISON EVENT) SATISFYING CONDITION 1-3 FOR VIRTUAL EVENT IN ALREADY GENERATED EVENTS
NO
GENERATING EVENT FROM VIRTUAL EVENT, AND ADDING EVENT TO PIN
END
YES
COMPARING DELAY BETWEEN COMPARISON EVENT AND VIRTUAL EVENT, AND DETERMINING PRIORITY LEVEL
S36
S38
UPDATING ROUTE IDENTIFICATION CODE HAVING LOWER PRIORITY LEVEL BETWEEN COMPARISON EVENT AND VIRTUAL EVENT
S37
IS CONDITION 4' (OR 4) SATISFIED BETWEEN COMPARISON EVENT AND VIRTUAL EVENT?
NO
S39
GENERATING EVENT FROM VIRTUAL EVENT, AND ADDING EVENT TO PIN
YES
S40
S42
PRIORITY LEVEL HIGHER FOR VIRTUAL EVENT?
NO
DISCARDING VIRTUAL EVENT (GENERATING NO EVENT FROM VIRTUAL EVENT)
YES
REPLACING CONTENTS OF COMPARISON EVENT WITH CONTENTS OF VIRTUAL EVENT
S41
END

FIG. 25

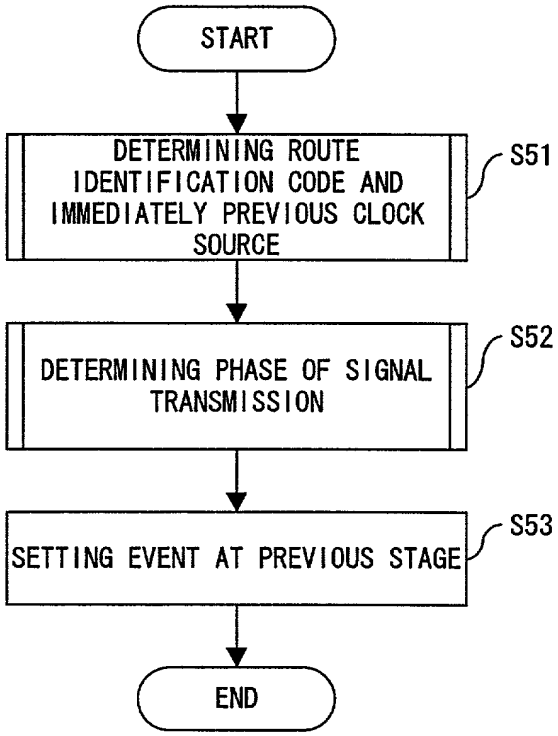

START
DETERMINING ROUTE IDENTIFICATION CODE AND IMMEDIATELY PREVIOUS CLOCK SOURCE
S51
DETERMINING PHASE OF SIGNAL TRANSMISSION
S52
SETTING EVENT AT PREVIOUS STAGE
S53
END

FIG. 26

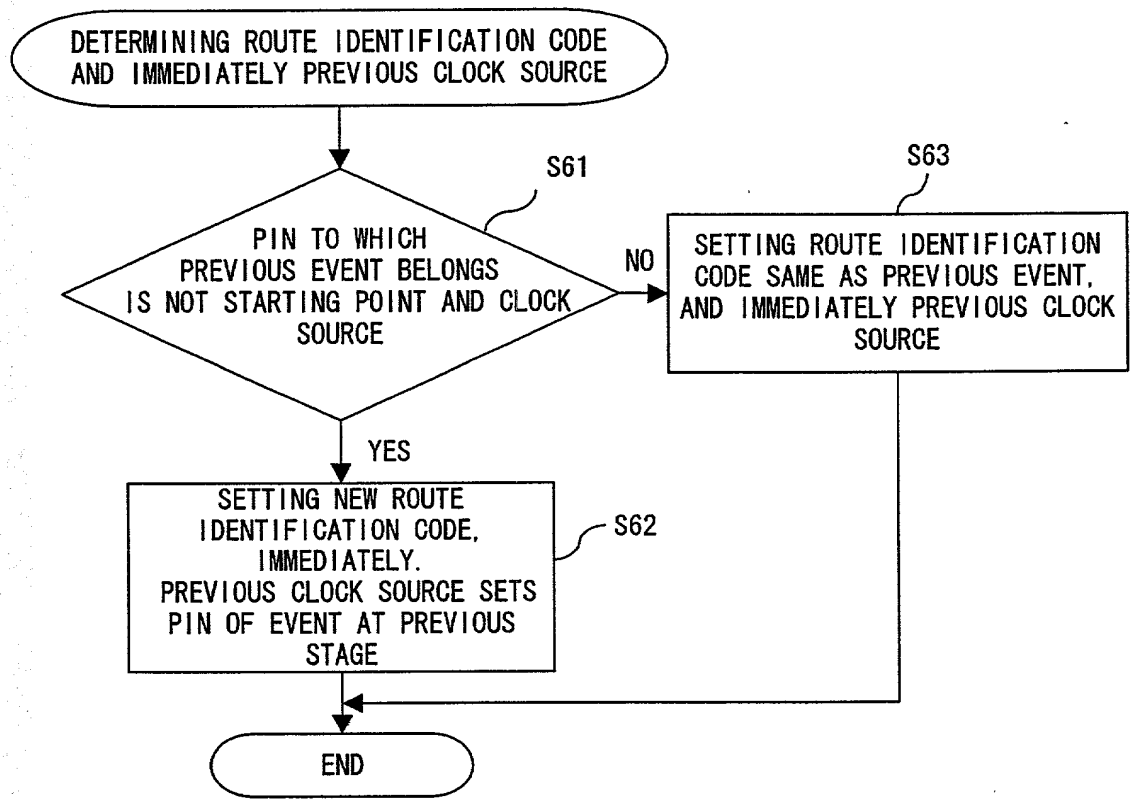

DETERMINING ROUTE IDENTIFICATION CODE AND IMMEDIATELY PREVIOUS CLOCK SOURCE
S61
PIN TO WHICH PREVIOUS EVENT BELONGS IS NOT STARTING POINT AND CLOCK SOURCE
NO
S63
SETTING ROUTE IDENTIFICATION CODE SAME AS PREVIOUS EVENT, AND IMMEDIATELY PREVIOUS CLOCK SOURCE
YES
SETTING NEW ROUTE IDENTIFICATION CODE, IMMEDIATELY. PREVIOUS CLOCK SOURCE SETS PIN OF EVENT AT PREVIOUS STAGE
S62
END

FIG. 27

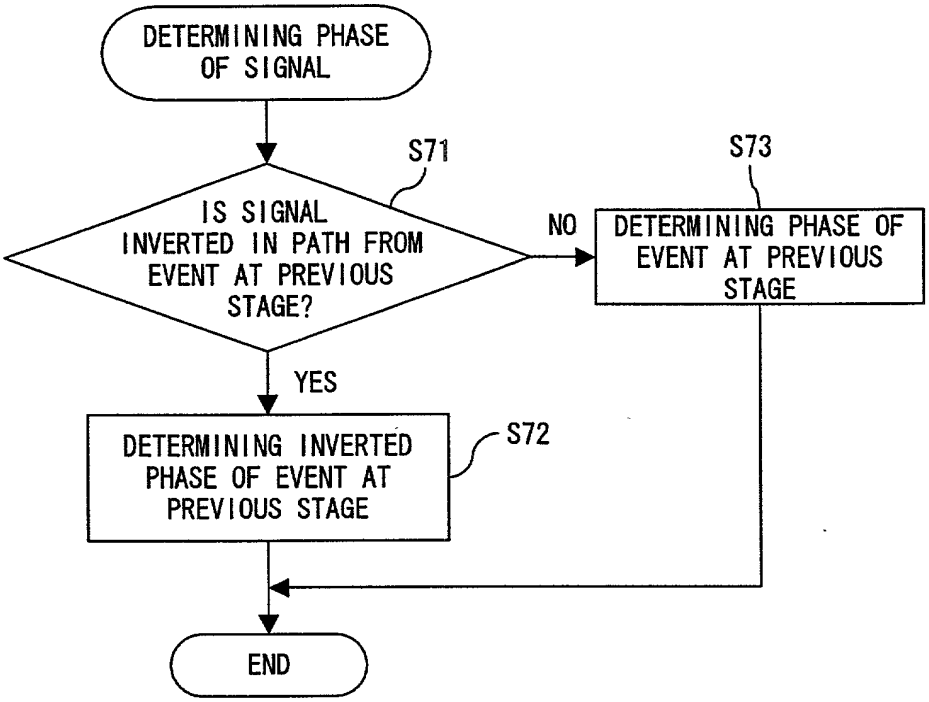

DETERMINING PHASE OF SIGNAL
S71
IS SIGNAL INVERTED IN PATH FROM EVENT AT PREVIOUS STAGE?
NO
S73
DETERMINING PHASE OF EVENT AT PREVIOUS STAGE
YES
DETERMINING INVERTED PHASE OF EVENT AT PREVIOUS STAGE
S72
END

FIG. 28

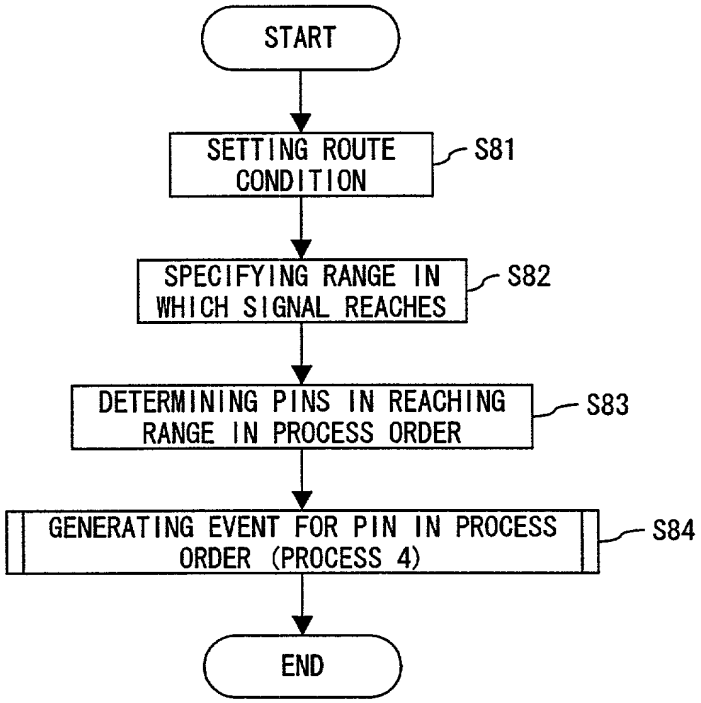

START
SETTING ROUTE CONDITION
S81
SPECIFYING RANGE IN WHICH SIGNAL REACHES
S82
DETERMINING PINS IN REACHING RANGE IN PROCESS ORDER
S83
GENERATING EVENT FOR PIN IN PROCESS ORDER (PROCESS 4)
S84
END

FIG. 29

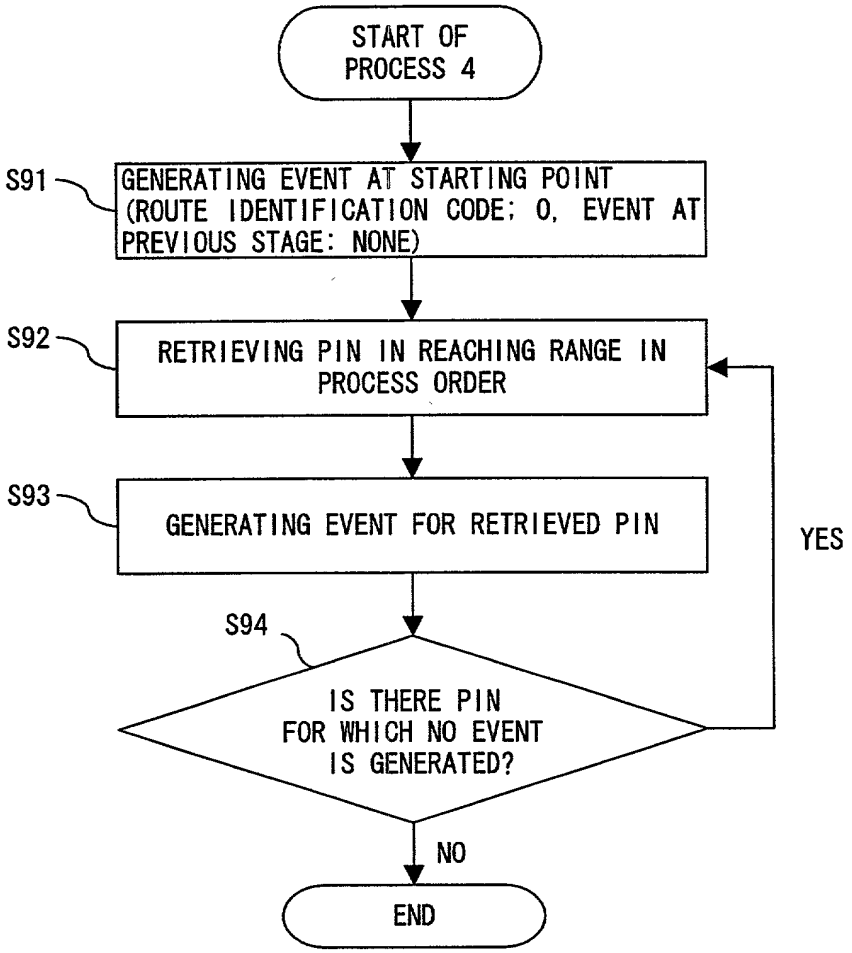

START OF PROCESS 4
S91
GENERATING EVENT AT STARTING POINT (ROUTE IDENTIFICATION CODE: 0, EVENT AT PREVIOUS STAGE: NONE)
S92
RETRIEVING PIN IN REACHING RANGE IN PROCESS ORDER
S93
GENERATING EVENT FOR RETRIEVED PIN
S94
IS THERE PIN FOR WHICH NO EVENT IS GENERATED?
YES
NO
END

FIG. 30

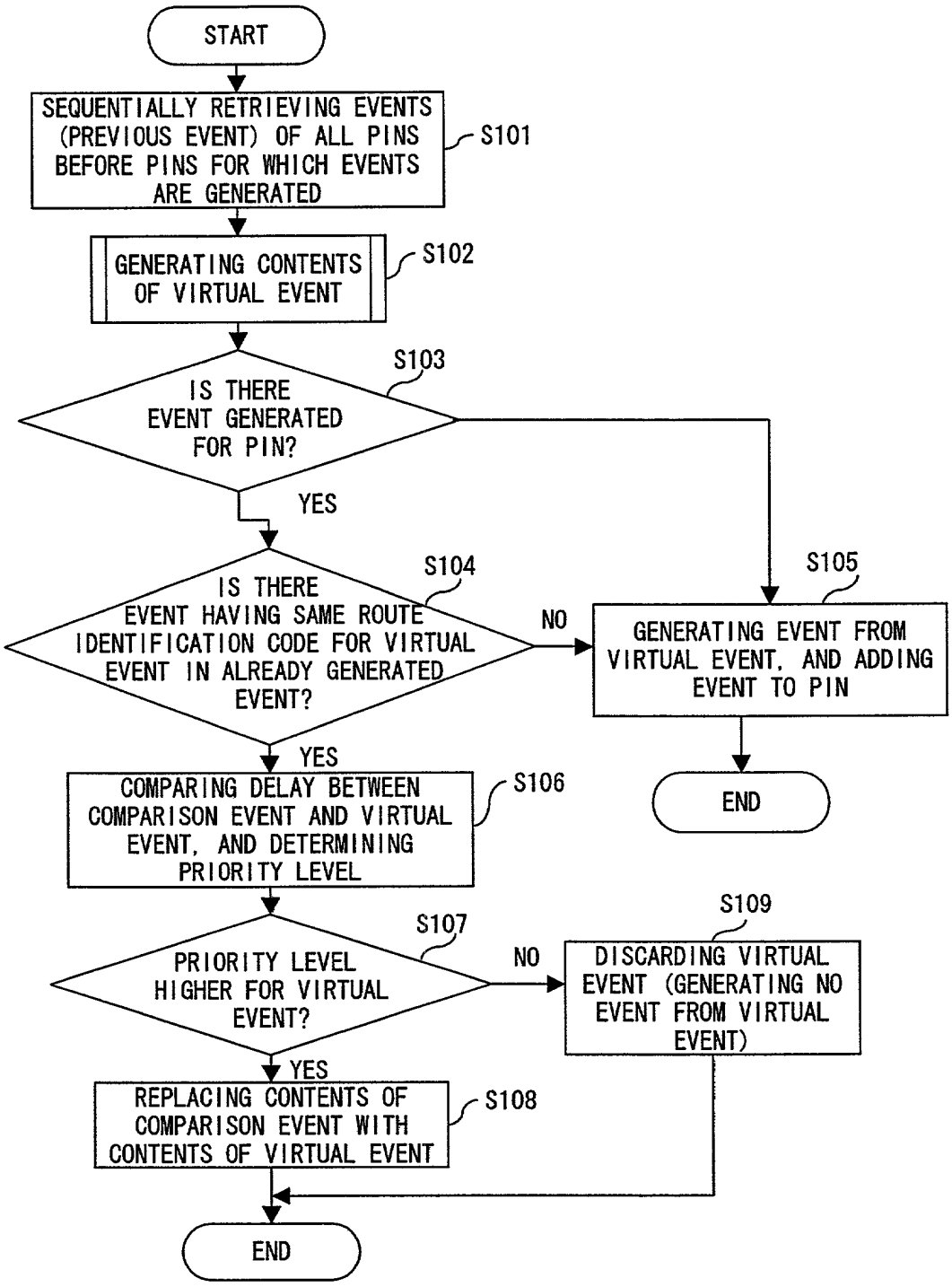

START
SEQUENTIALLY RETRIEVING EVENTS (PREVIOUS EVENT) OF ALL PINS BEFORE PINS FOR WHICH EVENTS ARE GENERATED
S101
GENERATING CONTENTS OF VIRTUAL EVENT
S102
S103
IS THERE EVENT GENERATED FOR PIN?
YES
S104
IS THERE EVENT HAVING SAME ROUTE IDENTIFICATION CODE FOR VIRTUAL EVENT IN ALREADY GENERATED EVENT?
NO
S105
GENERATING EVENT FROM VIRTUAL EVENT, AND ADDING EVENT TO PIN
END
YES
COMPARING DELAY BETWEEN COMPARISON EVENT AND VIRTUAL EVENT, AND DETERMINING PRIORITY LEVEL
S106
S107
PRIORITY LEVEL HIGHER FOR VIRTUAL EVENT?
NO
S109
DISCARDING VIRTUAL EVENT (GENERATING NO EVENT FROM VIRTUAL EVENT)
YES
REPLACING CONTENTS OF COMPARISON EVENT WITH CONTENTS OF VIRTUAL EVENT
S108
END

FIG. 31

Patent Application Publication

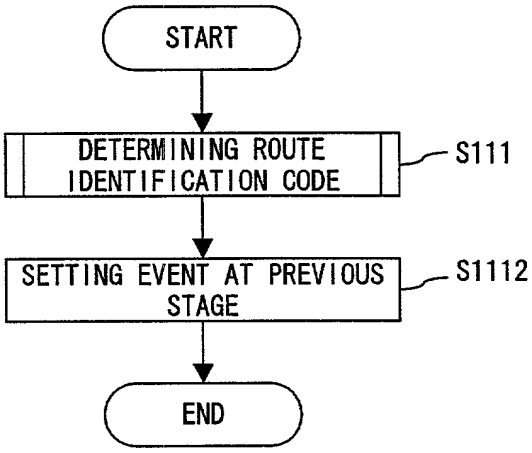


FIG. 32

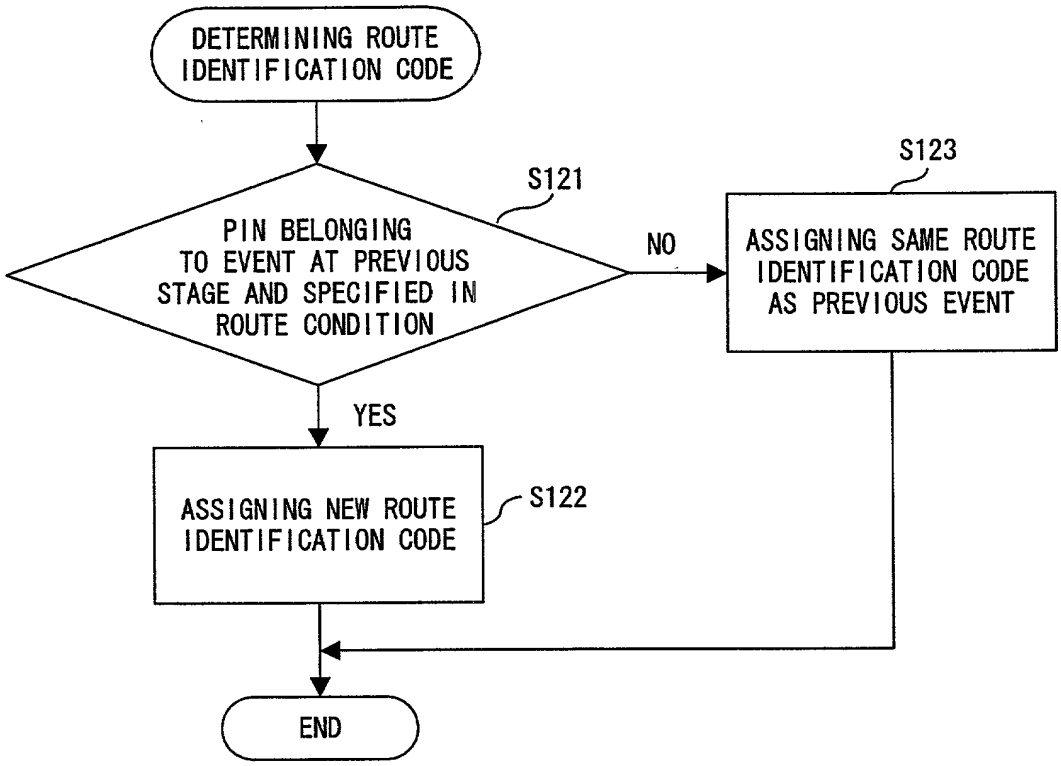

DETERMINING ROUTE IDENTIFICATION CODE
S121
PIN BELONGING TO EVENT AT PREVIOUS STAGE AND SPECIFIED IN ROUTE CONDITION
NO
S123
ASSIGNING SAME ROUTE IDENTIFICATION CODE AS PREVIOUS EVENT
YES
ASSIGNING NEW ROUTE IDENTIFICATION CODE
S122
END

FIG. 33

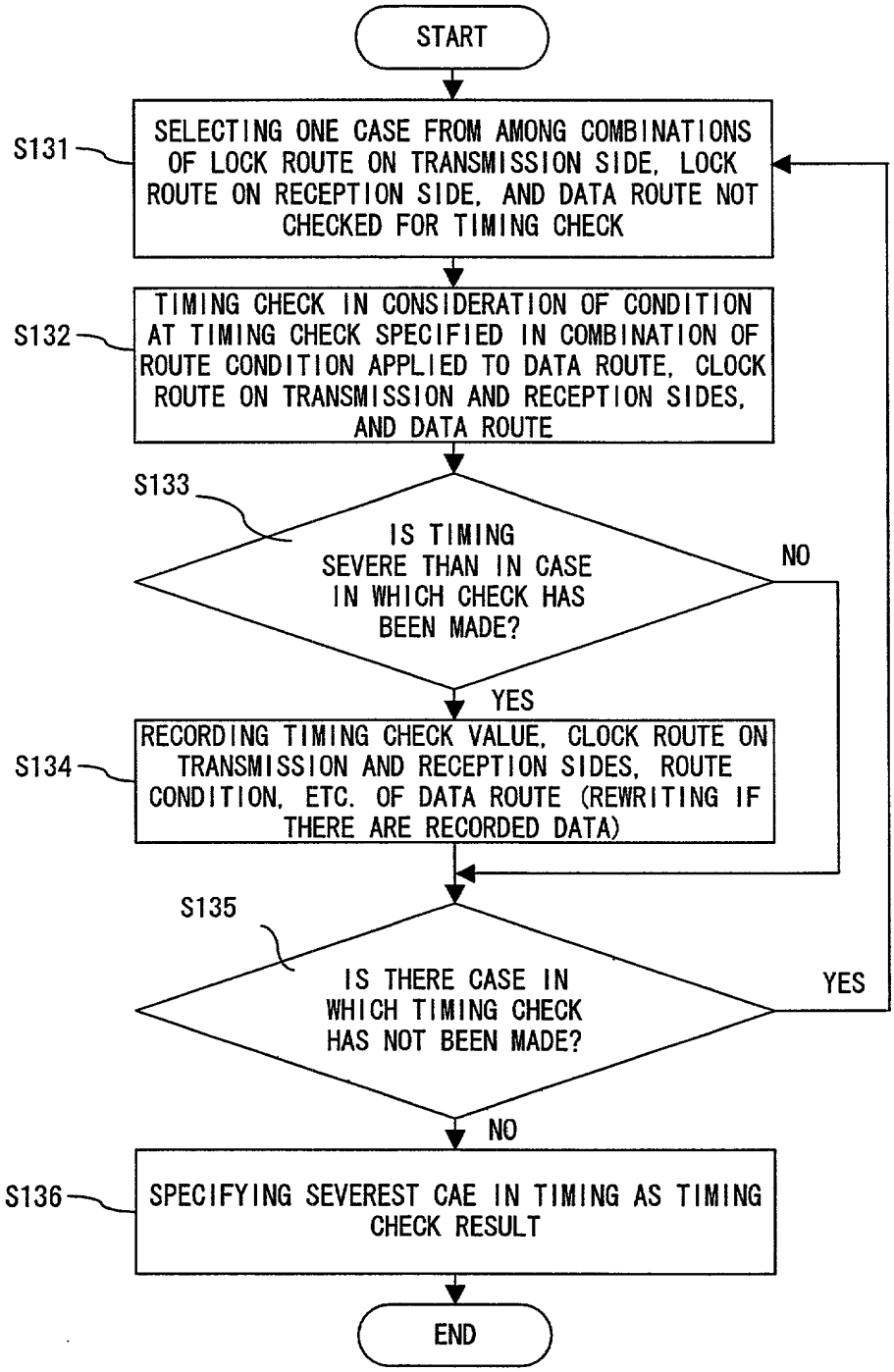

START
S131
SELECTING ONE CASE FROM AMONG COMBINATIONS OF LOCK ROUTE ON TRANSMISSION SIDE, LOCK ROUTE ON RECEPTION SIDE, AND DATA ROUTE NOT CHECKED FOR TIMING CHECK
S132
TIMING CHECK IN CONSIDERATION OF CONDITION AT TIMING CHECK SPECIFIED IN COMBINATION OF ROUTE CONDITION APPLIED TO DATA ROUTE, CLOCK ROUTE ON TRANSMISSION AND RECEPTION SIDES, AND DATA ROUTE
S133
IS TIMING SEVERE THAN IN CASE IN WHICH CHECK HAS BEEN MADE?
NO
YES
S134
RECORDING TIMING CHECK VALUE, CLOCK ROUTE ON TRANSMISSION AND RECEPTION SIDES, ROUTE CONDITION, ETC. OF DATA ROUTE (REWRITING IF THERE ARE RECORDED DATA)
S135
IS THERE CASE IN WHICH TIMING CHECK HAS NOT BEEN MADE?
YES
NO
S136
SPECIFYING SEVEREST CAE IN TIMING AS TIMING CHECK RESULT
END

FIG. 34

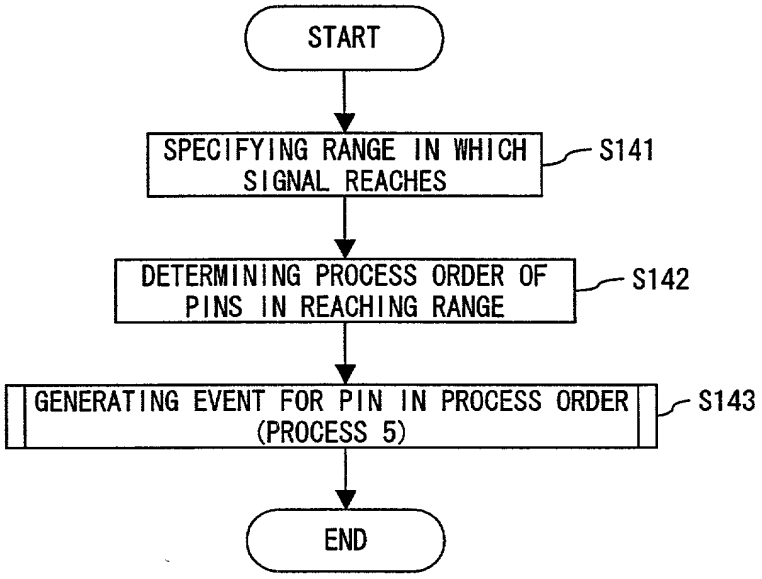

START
SPECIFYING RANGE IN WHICH SIGNAL REACHES
S141
DETERMINING PROCESS ORDER OF PINS IN REACHING RANGE
S142
GENERATING EVENT FOR PIN IN PROCESS ORDER (PROCESS 5)
S143
END

FIG. 35

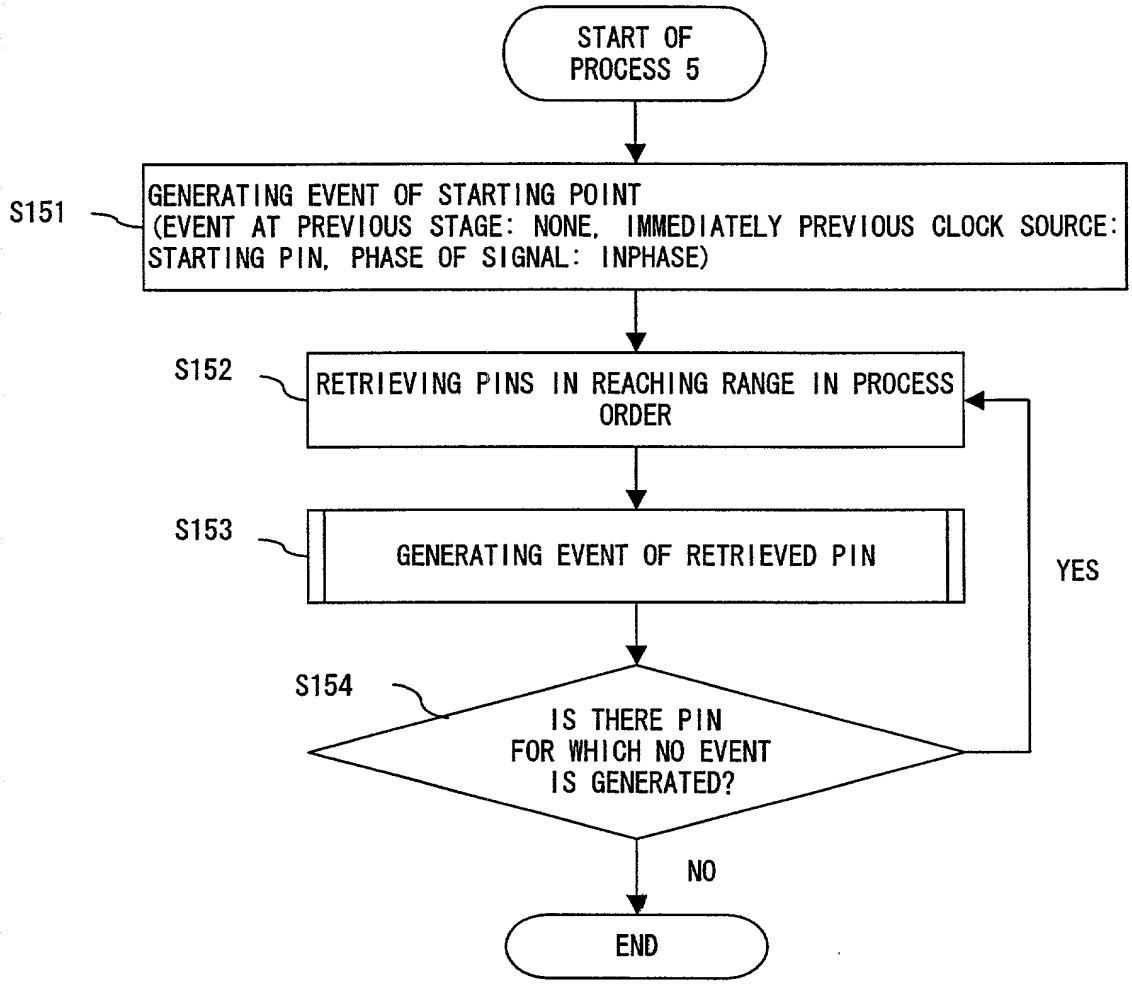

START OF PROCESS 5
S151
GENERATING EVENT OF STARTING POINT (EVENT AT PREVIOUS STAGE: NONE, IMMEDIATELY PREVIOUS CLOCK SOURCE: STARTING PIN, PHASE OF SIGNAL: INPHASE)
S152
RETRIEVING PINS IN REACHING RANGE IN PROCESS ORDER
S153
GENERATING EVENT OF RETRIEVED PIN
S154
IS THERE PIN FOR WHICH NO EVENT IS GENERATED?
YES
NO
END

FIG. 36

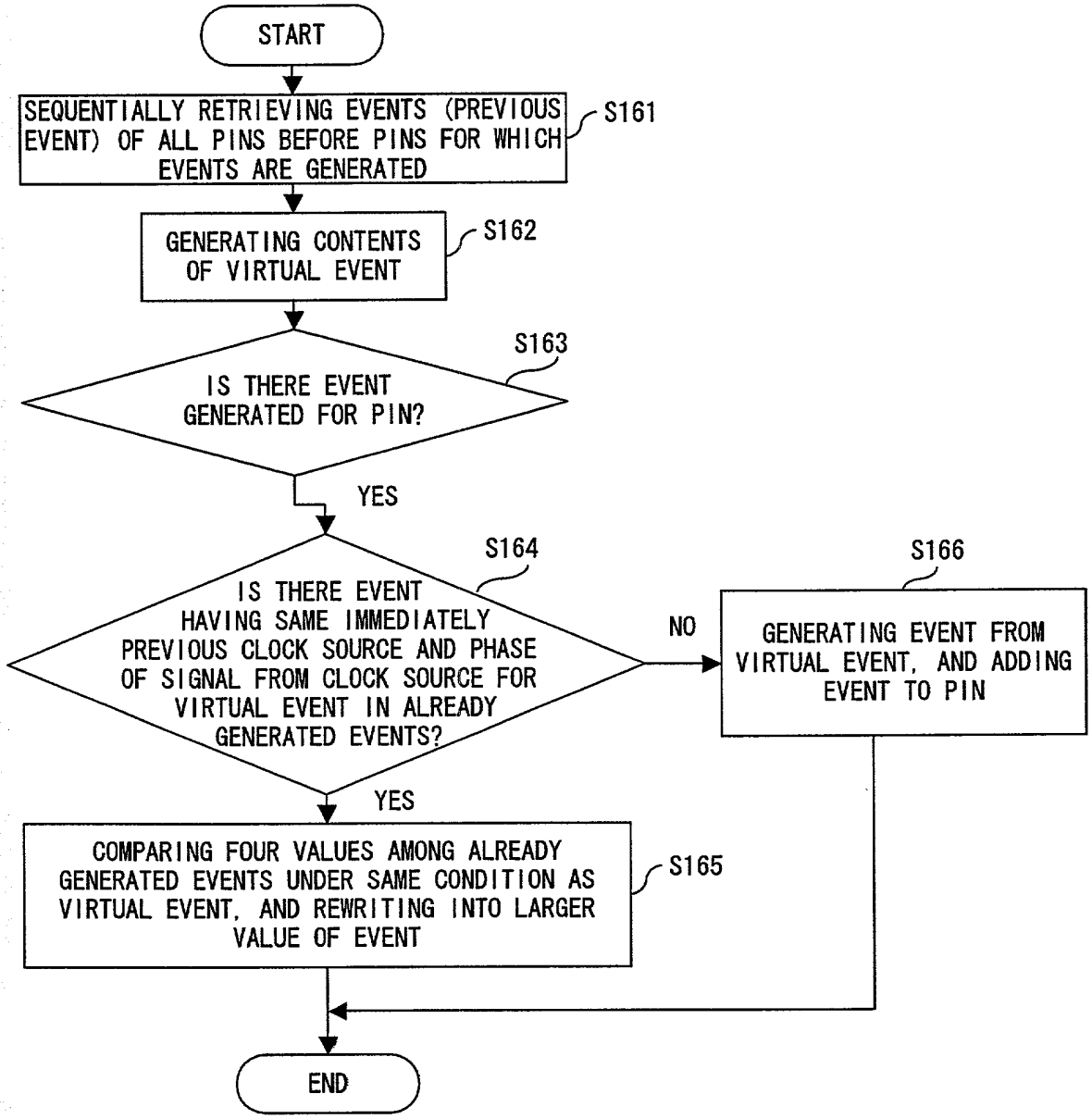

START
SEQUENTIALLY RETRIEVING EVENTS (PREVIOUS EVENT) OF ALL PINS BEFORE PINS FOR WHICH EVENTS ARE GENERATED
S161
GENERATING CONTENTS OF VIRTUAL EVENT
S162
S163
IS THERE EVENT GENERATED FOR PIN?
YES
S164
IS THERE EVENT HAVING SAME IMMEDIATELY PREVIOUS CLOCK SOURCE AND PHASE OF SIGNAL FROM CLOCK SOURCE FOR VIRTUAL EVENT IN ALREADY GENERATED EVENTS?
NO
S166
GENERATING EVENT FROM VIRTUAL EVENT, AND ADDING EVENT TO PIN
YES
COMPARING FOUR VALUES AMONG ALREADY GENERATED EVENTS UNDER SAME CONDITION AS VIRTUAL EVENT, AND REWRITING INTO LARGER VALUE OF EVENT
S165
END

FIG. 37